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ABSTRACT

This study investigates the relationship between pre-service teachers' locus of control and an application measure of science education achievement under a high and a low structured instructional treatment. Eighty college students enrolled in an elementary science methods class were administered aptitude tests which included a measure of locus of control (the James Internal-External Locus of Control Scale). The students were taught in a high-structure format - the traditional instructor-lecture mode with large-group follow-up discussions, or a low-structure format - individual study with small-group follow-up discussions. The subject matter dealt with planning science field trips for elementary school children. The results showed that the instructional treatments were related to the locus of control measure. (Author/BB)

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THE EFFECTS OF LOCUS OF CONTROL AND METHOD OF PRESENTATION ON PRE-SERVICE TEACHER'S ACHIEVEMENT

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THE EFFECTS OF LOCUS OF CONTROL AND METHOD OF PRESENTATION ON PRE-SERVICE TEACHER'S ACHIEVEMENT

Designing curricula and devising teaching methods to meet individual differences has long been a topic of educational research. Many researchers have noted that no single instructional process is optimal for all students (Glaser, 1968; Cronbach & Snow, 1969). However, only recently have studies investigated the inter-individual differences of students when exposed to various instructional procedures. The matching of instructional methods to students' aptitudes is the general area of aptitude-treatment-interaction research. It was the intent of this research to utilize ATI methods to study hypothesized relationships based upon the aptitude of locus of control and pre-service science education achievement under high and low structured instructional treatments.

The history of applying the locus of control construct to the educational process is a brief one. This aptitude is generally constructed along an internal-external continuum relating to a generalized belief about one's destiny. People generally classified as internal hold the belief that one's destiny is self-determined. They believe in their own ability to affect and to be in control of the events in their lives. In contrast, people generally classified as external hold the belief that their destiny is controlled by some outside force. Their values, expectations, and actions belie the belief that the outcomes of their efforts are highly dependent upon fate or others' actions. These destinies may

relate to such diverse areas as school achievement, social success, political ambitions and employment promotions. Recent studies have indicated that the presently available instruments each measure somewhat different aspects of locus of control and consequently should not be considered as interchangeable.

The evidence of locus of control differentially affecting achievement is mixed. Some researchers show that internals attain higher achievement test scores, while others find very little relationship between locus of control and achievement test scores. Lefcourt (1976, pp 66) stated

> The research. . .fails to support a simplistic, one-to-one relationship between locus of control and achievement. As in most instances when a topic is closely scrutinized, the observed relationships are found to be anything but simple and conclusive. Nevertheless, it will be apparent that locus of control plays a mediating role in determining whether persons become involved in the pursuit of achievement.

The preceding statement along with the numerour reported mixed findings correlating locus of control and academic achievement point out the need for studies such as the present one investigating possible interactions between educational treatment and the locus of control dimension of cognitive style.

Much educational literature also deals with lesson structure or overall classroom structure. In fact much of the philosophy underlying open education programs stresses low teacher structure and student assumption of an active role in choosing, initiating, undertaking, and evaluating projects. This is in contrast to the perceived traditional approach where students are rewarded for learning in a style and behaving in a mode structured by the teacher. Similarly studies working within Ausubel's "Advance Organizer Model" of expository teaching are dealing with structure

in lesson planning and expository teaching. Structure for this study was defined in terms of the degree to which students could vary their educational experiences and also the type of group interactions in which they were free to engage.

METHOD

Sample

Subjects for this study were 93 college students enrolled in an elementary science methods class. The students were initially enrolled in one section of the class, and then were randomly assigned to one of two sections on the first day of class. From the original sample, complete data was collected on 74 students. The others either dropped the course, did not attend class during the total treatment time, or desired not to be a part of the study and did not complete the aptitude measure during the designated time. The students were juniors and seniors and 79.8% of them were female.

Instruments

The aptitude or locus of control measure used in this study was the James Internal-External Locus of Control Scale (James, 1957). It consists of a 60 item questionnaire with the higher score representing more external orientation. Students mark each item along a 4 point scale from strongly agree to strongly disagree. The 30 even numbered items are scored while the 30 odd numbered items are considered filler items. This instrument was chosen because it was normed on samples of undergraduate students who should have possessed many characteristics similar to the ones involved in this study. It has a reported Spearman-Brown split half reliability of .89 for males and .94 for females. Additionally six month

test-retest reliabilities were reported as .76 for males and .78 for females.

The criterion measure was specifically designed for this study. It was an application level examination on the concepts presented. Two scores were obtained from the measure. One related to application of science processes and one related to application of science content in relationship to the treatment topic. No measure of reliability was determined for the criterion measure.

Treatment

Two alternative instructional programs were developed. The subject matter of both program modules dealt with planning science field trip activities for elementary school children. The total time spent on the treatment was 315 minutes. Introductory activities and materials were identical for each treatment group and filled the first 100 minutes of time. The criterion measure was administered during the final 15 minute treatment period.

After the introduction, one treatment was designed in a high structure format. The students were taught in the traditional instructor lecture mode. As a group they planned and participated in a science field trip activity. They were dependent upon the instructor for instructions, directions on what to do, time limits spent at specific activities and content relative to the processes of science identified. Additionally, follow up discussions were large group and teacher directed.

The alternative treatment was designed in a low structure format. The class identified various field trip sites and the students decided on their own the procedure for studying one site. They individually made

arrangements to visit their chosen site and also individually identified activities elemenatry school children could do relative to the processes of science. Additionally, follow up discussions were small group with students choosing or not choosing to discuss their individually chosen activity with other members of a small group.

Analysis of the Data

Data was analyzed utilizing an analysis of variance procedure in the ANOVA subprogram of SPSS. This determined whether or not differences in achievement exist between the two treatment groups and corresponds to the following null hypotheses.

1. There is no difference between the group means on an application test of science content.
2. There is no difference between the group means on an application test of science processes.

Secondly data was analyzed utilizing multiple linear regression techniques. This tested for the existence of possible interactions between treatments and locus of control and corresponded to the following null hypotheses.

3. There is no interaction between treatments and locus of control when a science content test is the criterion measure.
4. There is no interaction between treatments and locus of control when a science process test is the criterion measure.

Disordinal interactions were then analyzed by the Johnson-Neyman technique to find the areas of significant differences.

Results

The ANOVA procedure revealed that there were significant main effects on the science process measure but not on the science content measure.

Tables 1 and 2 summarize the results of the data analysis for the first two hypotheses.

TABLE 1

Main Effects Summary Table for the Science Content Test for High Structure and Low Structure Groups

Group	No. of Cases	Mean	Standard Deviation	Standard Error	t Value	p
Low Structure	33	10.9091	5.077	.884	-1.10	.273
High Structure	41	12.2927	5.573	.870		

TABLE 2

Main Effects Summary Table for the Science Process Test for High Structure and Low Structure Groups

Group	No. of Cases	Mean	Standard Deviation	Standard Error	t Value	p
Low Structure	33	4.8485	1.787	.311	-2.88	.005
High Structure	41	6.0244	1.710	.267		

Students in the high structure treatment group did significantly better on the application measure of science processes than did students in the low structure treatment group. Consequently aptitude-treatment interactions were only considered for the science content measure.

Before hypothesis 3 was considered, analyses were made to check the appropriateness of the linear regression model. An informal examination of the residuals furnished a visual check on the linearity assumption and on the homoscedasticity assumption (constant variance across the subpopulations). The Durbin-Watson statistic was used to check the independence of the residuals. The final step in checking the appropriateness of the model was to test the equality of the subpopulation variance for the high structure group with that of the low structure group. The F value was not significant at the .05 level and hence the assumption of equal variances could not be rejected.

Table 3 reports the values of the Durbin-Watson statistic for the high structure and low structure groups. The reported values do not fall within the critical region at the 0.05 level of significance for either group.

TABLE 3

Values of Durbin-Watson Statistic
for Each Regression Line

Independent Variable	Durbin-Watson Statistic
Content Achievement	
High Structure Group	2.1211[a]
Low Structure Group	2.0344[b]

[a]Critical region $D \leq 1.25$

[b]Critical region $D \leq 1.17$

The F-statistic computed was

$$F = \frac{\text{residual sum of squares for the H-S group}}{\text{residual sum of squares for the L-S group}} \times \frac{N_{H\text{-}S} - 2}{N_{L\text{-}S} - 2} = 0.701$$

with 39 and 31 degrees of freedom.

Since the appropriateness of the model was tested and the data appeared to satisfy the conditions, the comparison of the two regression lines was carried out. Tables 4 and 5 report the analysis of variance summary table and other statistics pertinent to the ATI hypotheses.

TABLE 4

Regression ANOVA Summary Table for Science Content Test

Source	SS	df
Regression		
High Structure	164.0967	1
Low Structure	216.2744	1
Residual		
High Structure	1078.3911	39
Low Structure	608.4529	31
Total		
High Structure	1242.4878	40
Low Structure	824.7273	32

TABLE 5

Statistics for Regression of Content Achievement on LOC Measure

Statistic	Value
Correlation Coefficient, R	
High Structure	.3634
Low Structure	.5121
Correlation Coefficient, R^2	
High Structure	.1321*
Low Structure	.2622**
Standard Error of the Estimate	
High Structure	5.2854
Low Structure	4.4302
Slope of Regression Line, b	
High Structure	.1729
Low Structure	-.2672
Intercept of Regression Line, a	
High Structure	5.9663
Low Structure	21.4577

* $p = .020$

** $p = .002$

The hypothesis of equality of slopes of the regression lines was tested using the F statistic:

$$F = \frac{\text{difference between b's residual mean square}}{\text{total residual mean square}}$$

with 1 and 71 degrees of freedom. Table 6 reports the statistics for this analysis.

TABLE 6

Analysis of Residual ss for Equality of Regression Line Slopes for Treatments

Sources	ss	df	ms	F	p
Within L-S Group	608.4528	31			
Within H-S Group	1078.3911	39			
Subtotal	1686.8439	70			
Total Within	2064.9183	71	24.0977		
Difference Between b's	378.0744	1	378.0744	15.681	<.01

This test found that the slopes were significantly different indicating the presence of a strong interaction between the treatments and the aptitude.

This aptitude-treatment interaction indicated that further analysis needed to be carried out to determine the region of significant interaction. The regression lines for the two treatments intersected at 35.20 which is near the midpoint of the range of scores for the James Locus of Control Scale. The range of scores for this study was 2 to 59. A graph of the

regression lines for the two treatment groups is given in Figure 1.

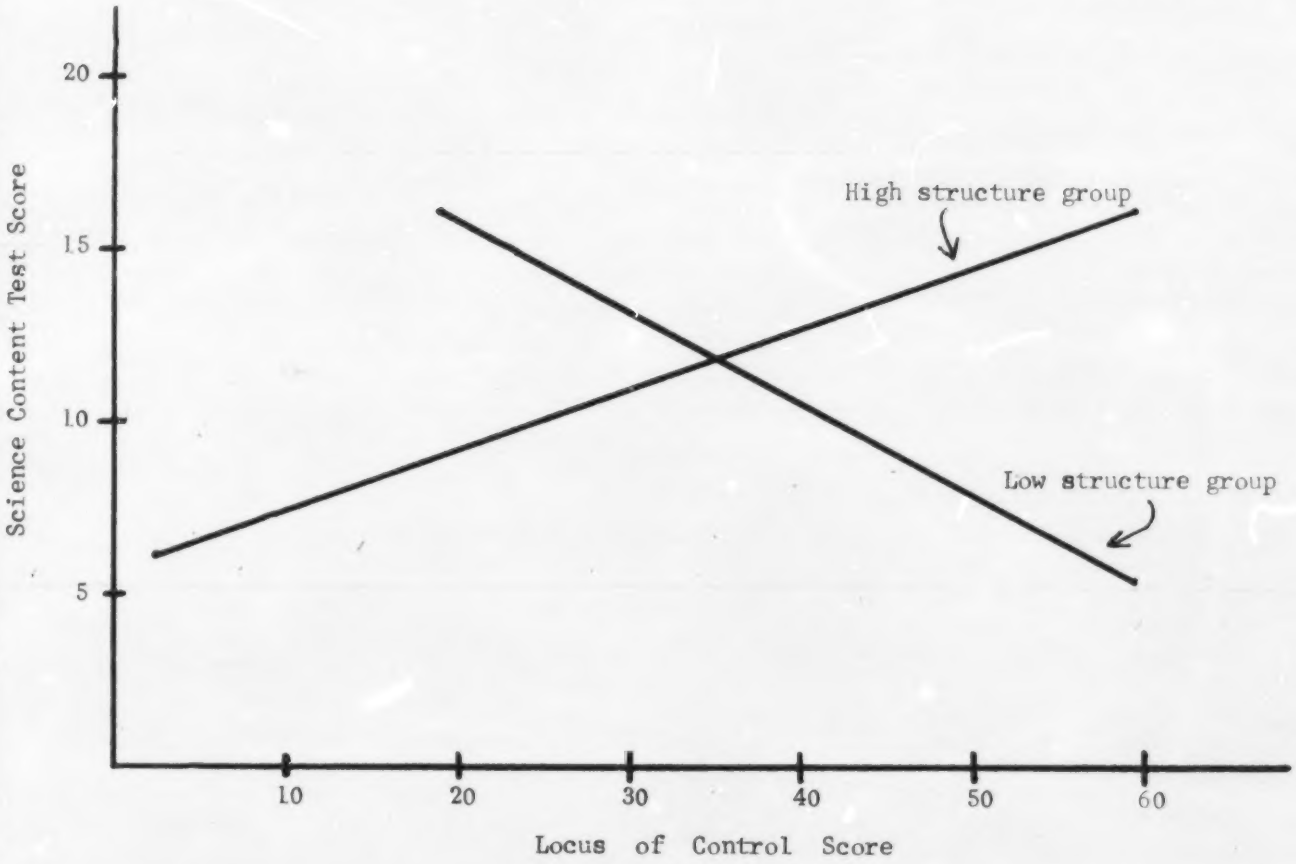

FIGURE 1. Regression Lines for Criterion Measure on Locus of Control Score

The additional analysis conducted employed the technique developed by Johnson and Neyman (1936) which permits the determination of the range of locus of control scores for which it is reasonable to assume that achievement differences between the two methods are statistically significant. Table 7 shows the basic statistics not already reported that are necessary to conduct the Johnson-Neyman analysis. The exact procedure used was that outlined by Kurlinger and Pedhazer (1973, p. 256).

TABLE 7

Basic Statistics for Johnson-Neyman Analysis

	High Structure Group N = 41	Low Structure Group N = 33
James I-E Locus of Control Scale		
mean	36.5854	39.4848
s.d.	11.7132	9.7311
Science Content Achievement Test		
mean	12.2927	10.9091
s.d.	5.5733	5.0767

The results of this analysis indicated that the ranges of locus of control scores for which statistically significant ($p < .05$) differences in achievement scores existed was from 2 to 26 and 42 to 59. The lower region showed significantly better achievement for persons in the low structure group and the upper region showed significantly better achievement for persons in the high structure group. Thus a disordinal interaction did exist which was significant for 43 % of the sample when the criterion measure was an application measure of science content.

DISCUSSION

The results of this study are intriguing. The strong interaction found between the locus of control measure and the high structure/low structure instructional methods must be viewed as quite encouraging. A previous review of ATI research (Bracht, 1970) revealed that only five out of ninety ATI studies have shown significant interactions. Since then these researchers are familiar with only few other reported studies (Daniels and Stevens, 1976) utilizing ATI hypotheses and locus of control construct. This study also found a strong interaction utilizing a traditional and a contract-for-grade method of instruction. This locus of control appears to be a viable aptitude when studying aptitude treatment interactions.

Another point of interest is the relationship between the main effects procedure which determined the high structure group achieved significantly better on the criterion measure of science process and the ATI procedures which determined significant results in favor of the internal students in the low structure group on the science content criterion measure. These results appear contradictory and may mean that the difficulty level of instructional material is a variable that must be considered when constructing research studies. Application of the science processes to elementary classroom activities may be more difficult than application of science content to elementary classroom activities. Clearly, further research is needed on additional samples to more clearly delineate the interaction effects of instructional treatment and locus of control.

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